United States Patent [19]

Higgins et al.

[11] **Patent Number: 4,501,017**

[45] **Date of Patent: Feb. 19, 1985**

[54] **SWITCH CONTROLLER FOR OBTAINING A PLURALITY OF FUNCTIONS FROM A SINGLE SWITCH IN A TWO-WAY TRANSCEIVER AND METHOD THEREFOR**

[75] Inventors: **Mary L. Higgins; David L. Muri,** both of Sunrise, Fla.

[73] Assignee: **Motorola, Inc.,** Schaumburg, Ill.

[21] Appl. No.: **462,486**

[22] Filed: **Jan. 31, 1983**

[51] **Int. Cl.**[3] **H04B 1/44;** H04B 1/02; H04Q 7/00

[52] **U.S. Cl.** **455/78;** 455/35; 455/38; 455/116; 340/825.44; 340/345

[58] **Field of Search** 455/31, 32, 34, 35, 455/38, 77, 78, 79, 84, 116, 91; 375/7, 68, 70; 340/309.15, 345, 696, 825.44; 370/32

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,500,458	3/1970	Cannalte	455/79
3,500,459	3/1970	Battin et al.	455/78
3,943,444	3/1976	Lundberg	455/32
4,037,158	7/1977	Eastmond	455/79
4,072,898	2/1978	Hellman et al.	340/696
4,396,910	8/1983	Enemark et al.	340/309.15

OTHER PUBLICATIONS

Motorola—MX 300 Series—"Handie-Talkie" Portable Radios.

Motorola—MC14022B—CMOS MSI.

Motorola—User's Manual—M6805—M146805 Family Microcomputer/Microprocessor.

Motorola—MC146805G2—CM)S 8-Bit Microcomputer.

Motorola—MCM2802—MOS—32×32 Bit Electrically Erasable Programmable Read Only Memory.

Foreign German Manual—Kodieraleitung Funftonfolge—Baustein FK 102-FK 103.

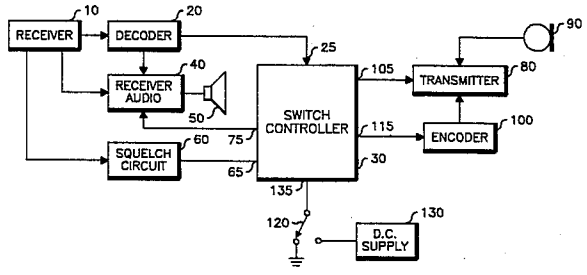
Primary Examiner—Jin F. Ng

Attorney, Agent, or Firm—Jerry A. Miller; James W. Gillman; Edward M. Roney

[57] **ABSTRACT**

In a transceiver, a multiple function switch decoder includes means for detecting actuation of the switch and means for monitoring the status of the receiver. A timer responsive to the monitoring means and detecting means establishes a predetermined time interval following each switch actuation or each received message of predetermined type. When the switch is actuated during the time interval the transmitter is enabled. When the switch is activated outside the time interval the receiver audio is activated so the user may monitor the channel. During the first switch actuation in any given time interval an encoder is enabled. On subsequent switch actuations during the same time interval the encoder is inhibited. This allows a single switch to perform a plurality of transmitter and receiver functions.

31 Claims, 6 Drawing Figures



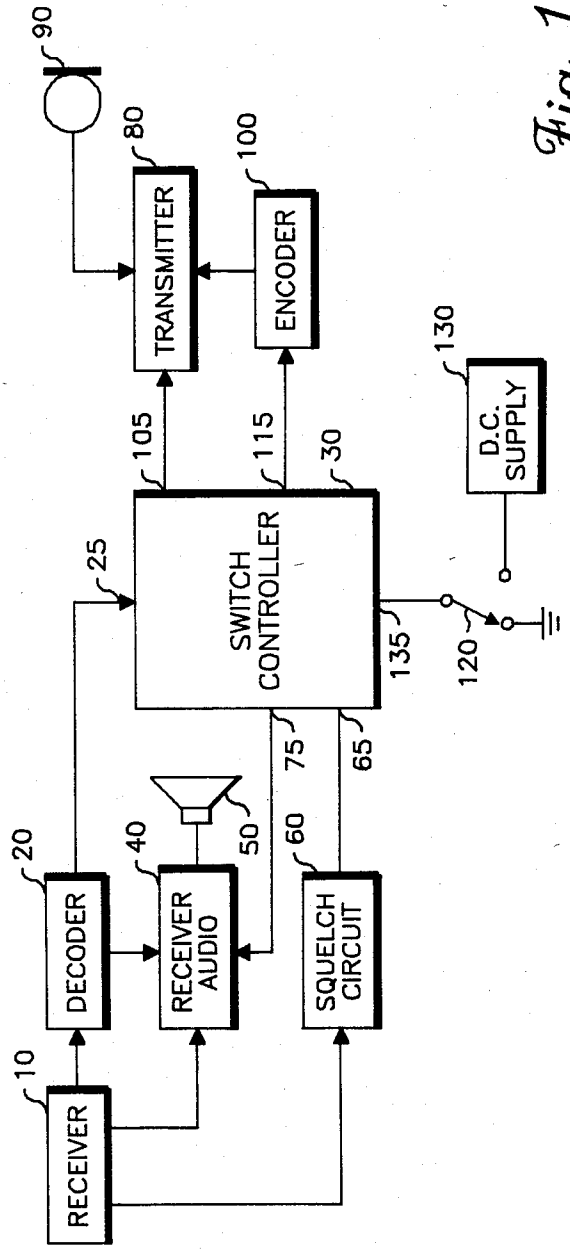

90
80
TRANSMITTER
100
ENCODER
130
D.C. SUPPLY
105
115
30
SWITCH CONTROLLER
25
135
120
75
65
20
40
50
60
DECODER
RECEIVER AUDIO
SQUELCH CIRCUIT
10
RECEIVER

Fig. 1

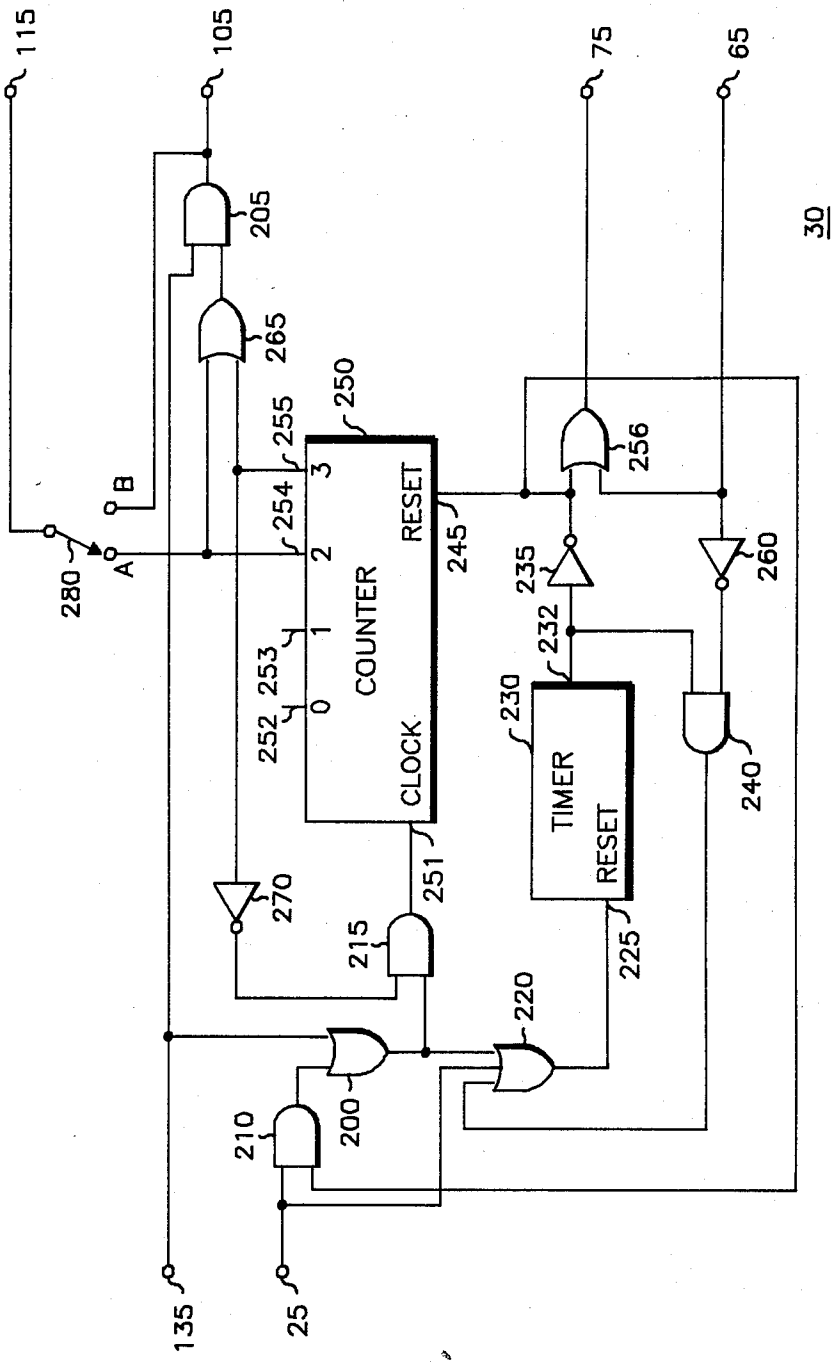

115
105
75
65
30
205
265
250
255
254
253
252
280
B
A
COUNTER
RESET
CLOCK
245
256
235
260
232
230
TIMER
RESET
240
270
251
215
225
220
200
210
135
25

Fig. 2

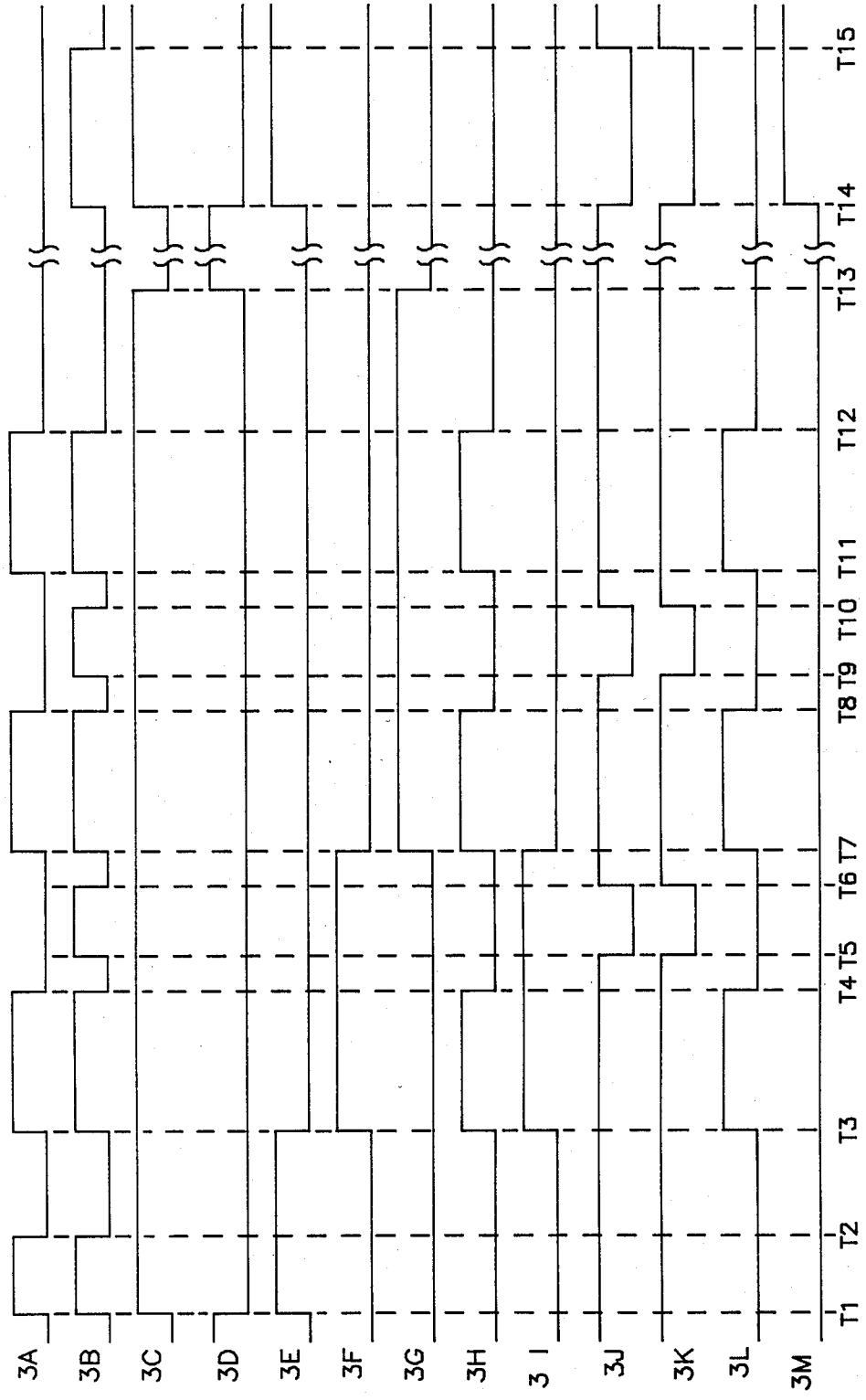

T15
T14
T13
T12
T11
T10
T9
T8
T7
T6
T5
T4
T3
T2
T1
3A
3B
3C
3D
3E
3F
3G
3H
3 I
3J
3K
3L
3M

Fig. 3

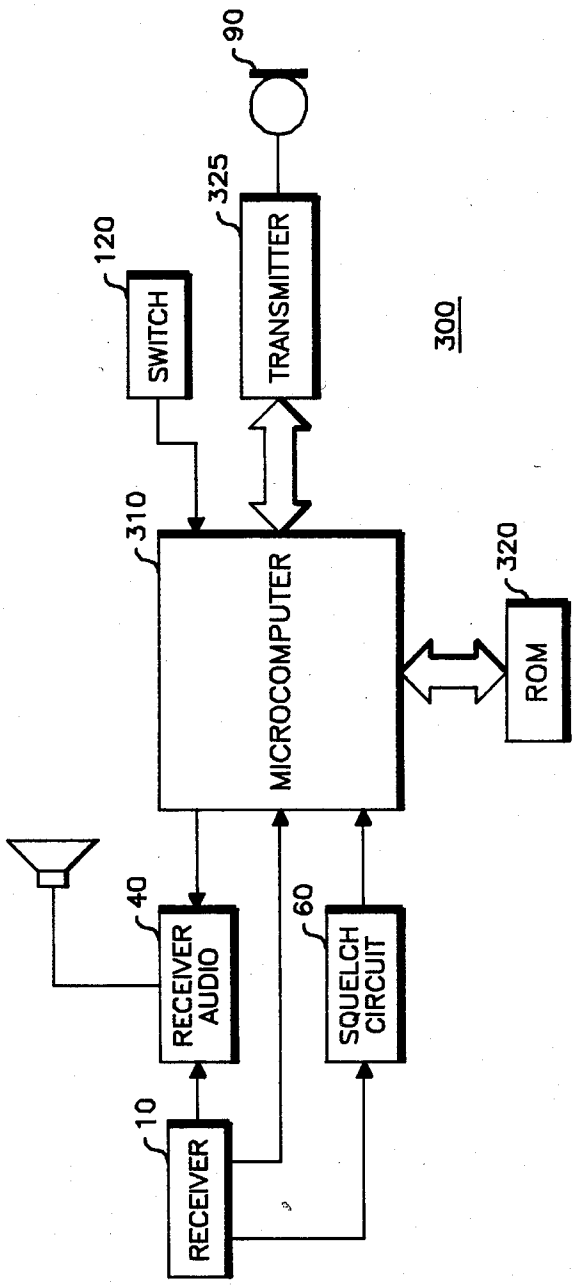

90
325
TRANSMITTER
120
SWITCH
300
310
MICROCOMPUTER
320
ROM
40
RECEIVER AUDIO
60
SQUELCH CIRCUIT
10
RECEIVER

Fig. 4

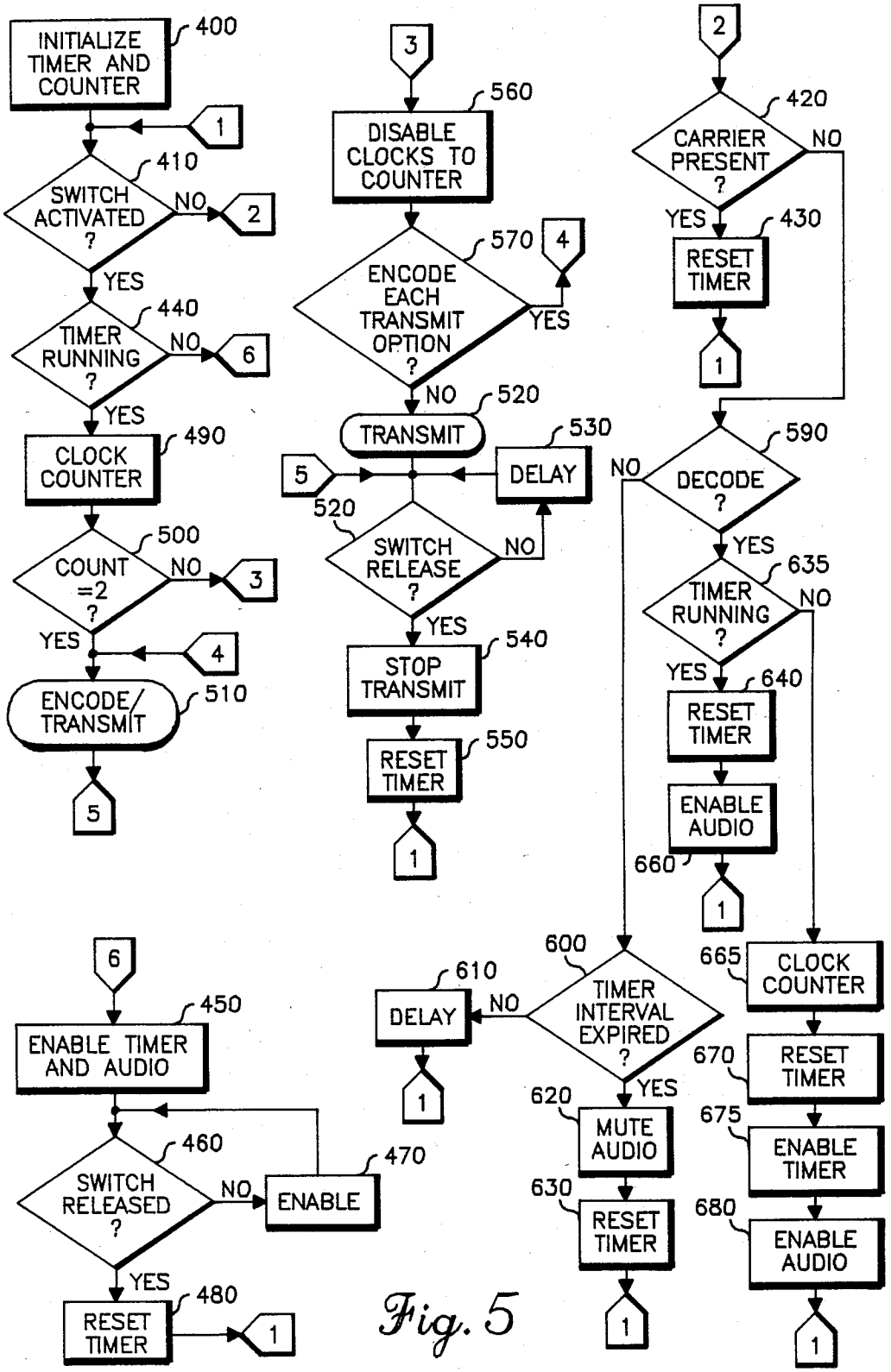

INITIALIZE TIMER AND COUNTER
400
1
SWITCH ACTIVATED ?
410
NO
2
YES
TIMER RUNNING ?
440
NO
6
YES
CLOCK COUNTER
490
COUNT =2 ?
500
NO
3
YES
4
ENCODE/ TRANSMIT
510
5
3
DISABLE CLOCKS TO COUNTER
560
ENCODE EACH TRANSMIT OPTION ?
570
4
YES
NO
TRANSMIT
520
DELAY
530
5
SWITCH RELEASE ?
520
NO
YES
STOP TRANSMIT
540
RESET TIMER
550
1
2
CARRIER PRESENT ?
420
NO
YES
RESET TIMER
430
1
DECODE ?
590
NO
YES
TIMER RUNNING ?
635
NO
YES
RESET TIMER
640
ENABLE AUDIO
660
1
6
ENABLE TIMER AND AUDIO
450
SWITCH RELEASED ?
460
NO
ENABLE
470
YES
RESET TIMER
480
1
DELAY
610
NO
1
TIMER INTERVAL EXPIRED ?
600
YES
MUTE AUDIO
620
RESET TIMER
630
1
CLOCK COUNTER
665
RESET TIMER
670
ENABLE TIMER
675
ENABLE AUDIO
680
1

Fig. 5

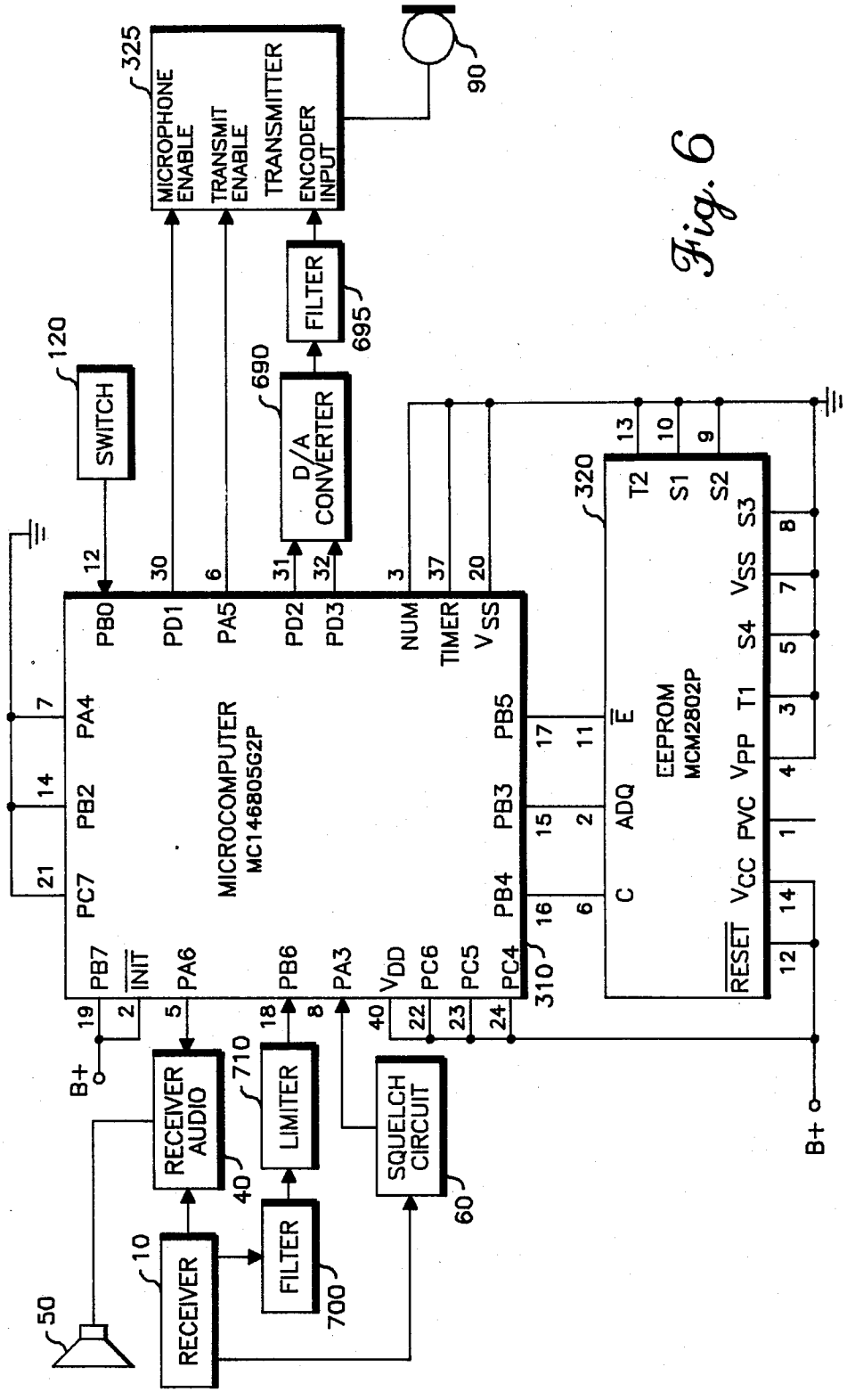

325
MICROPHONE ENABLE
TRANSMIT ENABLE
TRANSMITTER ENCODER INPUT
90
FILTER
695
120
SWITCH
690
D/A CONVERTER
320
T2
S1
S2
S3
VSS
S4
T1
VPP
PVC
VCC
ADQ
C
E
RESET
EEPROM MCM2802P
MICROCOMPUTER MC146805G2P
PB0
PD1
PA5
PD2
PD3
NUM
TIMER
VSS
PA4
PB2
PC7
PB7
INIT
PA6
PB6
PA3
VDD
PC6
PC5
PC4
PB5
PB3
PB4
310
B+
RECEIVER AUDIO
40
710
LIMITER
SQUELCH CIRCUIT
60
50
10
RECEIVER
FILTER
700

Fig. 6

SWITCH CONTROLLER FOR OBTAINING A PLURALITY OF FUNCTIONS FROM A SINGLE SWITCH IN A TWO-WAY TRANSCEIVER AND METHOD THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the field of control circuits for electronic equipment. More particularly, this invention relates to a controller which permits a single switch to perform a plurality of transceiver functions which may be dependent upon the status of the receiver or the transmitter, or the recent actuation history of the switch itself.

2. Background of the Invention

As the state of the art in the electronic industry progresses, the trend is towards ever smaller electronic devices which must reliably perform a variety of functions. An example of this trend may be found in the field of electronic calculators. While the predecessor of the modern pocket calculator literally occupied rooms, devices with similar computational power which will fit in a shirt pocket are now commonplace. Such devices often have control buttons which electronically address a number of different features per button in order to provide the user with a large number of features in a small package. This is accomplished by using a "second feature button' which is actuated prior to the actuation of a button which addresses a plurality of features. Therefore, in order for the user to address the features of his calculator, two button actuations are required to address a single feature.

In the field of portable radio transceivers, there is a similar size reduction trend taking place. As the size of these devices diminishes, the number of control features incorporated in a single control switch must also increase in order for the user to control the additional electronic features incorporated therein.

This is particularly true for selective calling portable radio transceivers (radio transmitter/receivers) such as those commonly used throughout Europe. In these systems the user is required by regulation to monitor his receiver prior to making any transmission to assure that there is no channel activity taking place on the communication channel he intends to use. Once the user establishes that the channel is free of activity, he must normally transmit a series of tones or a digitally encoded message in order to address the receiver or repeater he desires to contact. For example, in the well known ZVEI (Zentral Verband der Elektro-Industrie) system commonly used in Germany, an address code consists of a sequence of five audio frequency tones between 1060 Hz and 2600 Hz which are consecutively transmitted. Each tone has a 70 millisecond duration with no pause between tones. Each tone represents a single digit 0–9 (or a repeat tone indicating that the preceeding digit is repeated). Each user or repeater is assigned a five digit address which must be correctly decoded to access that receiver or repeater. Encoding and decoding circuits for such systems are well known. Having established receiver or repeater access, the user is then free to carry on normal two way voice or data communications with another transceiver.

One scheme often used to accomplish the above sequence of steps is to provide the portable transceiver with three switches. In operation, the user firsts actuates a "push-to-monitor" switch which enables the receiver section audio so that the user may determine if there is activity taking place on the desired radio frequency channel. When the channel is clear, the user actuates a second switch which transmits an appropriate code word in tones or binary digits, as for example, a set of five sequential tones of predetermined length and frequency, to access the desired receiver. The user then actuates a third switch to enable his transmitter and microphone in order to carry on normal conversation.

In the above transceiver scheme, a total of three switches are required to perform even the most basic selective calling transceiver functions. In addition to these controls, the transceiver must also include a volume control, an on/off switch, a squelch control, a channel selector control, and quite possibly many other controls such as a telephone style keypad for more sophisticated transceivers. It is evident that utilizing three separate switches simply to control the sequence of steps necessary for initialization of a conversation is highly inefficient. As these transceivers incorporate more and more features and options, the switch requirement becomes a severe size limitation in a portable or mobile transceiver.

Another scheme often used in portable transceivers, such as Motorola's European version of its MX300 series of transceivers, utilizes a momentary push-to-talk type switch in conjunction with a three position toggle switch. This exemplifies the utilization of a two switch requirement for the selection of any transceiver function. In this scheme a first position of the toggle switch places the radio receiver in a coded squelch mode. This makes the radio reciever responsive only to tone or digitally encoded messages bearing an appropriate user address code. The center position of the toggle switch places the receiver in the carrier squelch mode which allows the receiver to turn on its audio amplifier and speaker upon receipt of any message on the communication channel without regard to coding. The third position of the toggle switch enables the transmitter and transmits the encoded message required to access a receiver or repeater.

In operation, if the user wishes to initiate a call he switches the toggle switch from the coded squelch position to carrier squelch position in order to monitor the channel for activity by other users. He then moves the toggle switch to the encode mode to transmit an appropriate address code to access an appropriate receiver. The user may then utilizes his "push-to-talk" (PTT) switch in a normal manner as necessary to carry on the desired conversation. This system has the advantage of forcing the user to monitor the channel prior to transmitting the code to access a receiver since he has to pass through the carrier squelch position of the three position switch in order to initiate a call. After completing the conversation, the user must switch his transceiver back to the coded squelch mode.

Another two switch system is used in radios such as the GRUNDIG MODEL FK103. In this system a first switch turns ON the receiver audio so that the user may monitor the channel. Deactuation of the switch places the transceiver in a coded squelch mode. Actuation of the second switch while in the coded squelch mode reverts the receiver to carrier squelch and transmits the address code. All subsequent transmissions are without encoding and the first switch is actuated again to place the radio back in the coded squelch mode.

Although these systems reduce the number of switches required to two, operation of the transceiver with one hand can be quite awkward. They inefficiently utilize valuable transceiver controls to actuate only basic transceiver functions not to mention increasing their cost. Also, the user is required in each case to manually place the transceiver back in a coded squelch mode after conversation has ended.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved controller for a multiple function switch.

It is another object of the present invention to integrate a plurality of switching functions in a single switch for a transceiver.

It is another object of the present invention to provide an efficient switch scheme for initiating communications with a portable transceiver in a selective calling communications system.

It is another object of the present invention to provide a controller which allows a single switch to perform a plurality of functions in a portable transceiver as a result of receiver conditions, transmitter conditions, and activity of the switch itself.

It is a further object of the present invention to provide a controller for efficient utilization of switches in a miniature portable transceiver.

In one embodiment of the present invention. A transceiver has a multiple function switch controller including a timer for a establishing a time interval. A first circuit produces a first control signal when the switch is actuated during the time interval, and a second circuit produces a second control signal when the switch is actuated outside the time interval.

In another embodiment of the present invention, a multiple function switch controller includes an apparatus for detecting the actuation of a switch and a circuit for monitoring the status of a communication channel. A timer responsive to either the monitoring circuit or the switch detecting apparatus establishes a time interval. A transmitter enabling circuit enables the transmitter upon actuation of the switch during the time interval and an annunciation circuit annunciates the status of the communication channel upon actuation of the switch outside the time interval.

In another embodiment of the present invention, a transceiver includes a multiple function switch controller having an apparatus for decoding a received signal having a predetermined address. A timer responsive to the decoder establishes a time interval following each received signal having a predetermined address. A first circuit responsive to the actuation of the switch produces a first control signal if the switch is actuated during the time interval. A second circuit produces a second control signal if the switch is actuated outside the time interval.

In another embodiment of the present invention, a transceiver has a multiple function switch controller including a circuit for detecting actuation of the switch and a decoder for decoding received signals of a predetermined type. A timer responsive to either the decoder or the switch detector circuit establishes a time interval following each decoding of a received message of a predetermined type. A controller circuit causes the switch to activate a first function if actuated during the time interval and a second function if actuated outside of the time interval.

In another embodiment of the present invention, a method of controlling a multiple function switch includes the steps of providing a timer to establish time intervals, detecting whether or not the timer's output is predetermined active, counting the number of switch actuations occuring while the output is a predetermined signal, enabling an encoder if the count equals a first predetermined count and inhibiting the encoder if the count is equal to a second predetermined count.

The features of the invention believed to be novel are set forth with particularity in the appended claims. The invention itself however, as to organization, method of use, and method of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a hardware implementation of the present invention embodied in a transceiver.

FIG. **2** is a detailed electrical schematic of a hardware embodiment of the controller portion of the present invention.

FIG. **3** is a timing diagram of the conroller of FIG. **2**.

FIG. **4** is a system block diagram for a microcomputer implementation of the present invention embodied in a transceiver.

FIG. **5** is a flow chart detailing the operation of the controller portion of the present invention.

FIG. **6** is a combined functional block diagram and electrical schematic showing the hardware to utilize a preferred microprocessor embodiment of the present invention for FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. **1**, a receiver **10** is coupled to an address decoder **20** and receives modulated coded information from a radio channel. An address decoder **20** examines that information to determine if the transceiver is being selectively addressed by an appropriately encoded transmission. An indication of a correctly encoded address is then provided to an input **25** of a switch controller **30** for processing. This information is also provided to a receiver audio circuit **40** so that voice information received after the detected coded address may be transferred to a speaker **50** in the preferred embodiment. Receiver **10** also provides a squelch circuit **60** with information, usually audio noise, for the purposes of determining whether or not there is an on channel signal, correctly encoded or not, being received by receiver **10**. This squelch information is transferred by switch controller **30** at a controller input **65** where it may be processed and delivered to the receiver audio via an output **75**.

A transmitter **80** can receive inputs either from a microphone **90** or an address encoder **100**, for modulation and transmission on the radio frequency communication channel. It is understood by those skilled in the art that transmitter **80** as well as receiver **10** may be AM, FM, PM or any combination or variation thereof without loss of generality. In the preferred embodiment, a narrowband FM system is used.

Transmitter **80** is enabled by a signal from switch controller **30** at a controller output **105**. Switch controller **30** also determines when encoder **100** should generate an address code by providing encoder **100** with an enabling signal from a controller output **115**. In the

preferred embodiment a momentary switch **120** is normally grounded on one side. Actuation of the switch connects that side of the switch to a logic high in the form of a DC supply **130**. The other side of switch **120** is coupled to an input **135** to switch controller **30**.

In operation, the system functions in the following manner. If the user desires to initiate a transmission, he first actuates switch **120**. If switch controller **30** has received an indication of channel activity at its input **65**, the receiver's audio is turned on by output **75** so that the user may hear that channel activity on speaker **50** thereby annunciating the channel status to the user. In the alternative, other ways of annunciating the channel status such as a visual display or light may be preferred in some cases. When the user has determined that the channel is free of activity he actuates the same switch **120** for a second time. The second actuation must occur within a predetermined time interval established at deactuation of the first actuation of switch **120**. Upon receiving the second switch actuation, switch controller **30** sends a control signal at output **115** enabling address encoder **100**. It also sends a signal at output **105** actuating transmitter **80**. Encoder **100** provides transmitter **80** with the address code, such as a ZVEI tone sequence, for the desired receiver and preferrably instructs transmitter **80** to mute any inputs from microphone **90** while the address is being encoded. Microphone **90** is muted at this time to prevent voices or noises entering the microphone from corrupting the encoder generated address.

After the brief period of time required for the encoder **100** and transmitter **80** to send out the address, microphone **90** is unmuted and the user can begin his conversation. If the party being called responds within a predetermined period of time established by the last deactuation of the user's switch **120**, he may do so in an uncoded transmission mode in the preferred embodiment. The present user's receiver will acknowledge receipt of that message by transferring voice information from receiver audio **40** to speaker **50**. After receiving that transmission the user will typically respond with more voice information in a manual two-way conversation. This is accomplished by once again actuating switch **120** within a predetermined time interval established at the end of the received transmission as indicated by loss of radio frequency carrier.

Upon a third actuation of switch **120** within a predetermined time interval of receiving the last message, a signal at output **105** once again enables transmitter **80** and voice transmission may once again occur. In one embodiment of the present invention, the user may select at his descretion whether or not encoder **100** is actuated at such a time. This is the type of system option that may be useful in a number of communication systems. The system operates in a manner identical to its operation during the last reception and transmission on subsequent receptions and transmissions as long as they occur within the time interval established by the switch controller **30**.

In all cases of the preferred embodiment this time interval begins upon deactuation of switch **120** or the end of a received message. In the preferred embodiment this time interval is controlled by a programmable timer which can be set anywhere from several milliseconds to several minutes. A time interval of approximately 7 seconds has been found to be convenient. If either the receiving or transmitting party fails to respond within the predetermined time interval, the transceiver automatically reverts back to the coded squelch mode. The next actuation of switch **120** causes the transceiver to operate as if it is the first actuation of switch **120** thereby restarting the operation sequence without the necessity of manual intervention by the user.

If, rather than a user initiated transmission, a conversation is initiated by receipt of a properly encoded message, address decoder **20** provides switch controller **30** with a signal at input **25**. This signal directs switch decoder **30** to enable transmitter **80** upon the first actuation of switch **120** and places the receiver in a non-coded squelch (carrier squelch) mode. The initial switch actuation which is necessary to prevent interference when initiating a call is bypassed automatically when a conversation is initiated by receipt of a properly encoded message. Since that initial actuation is carried out by the party initiating the call. Thus the controller operation is made dependent on both user initiated switch actuations and messages received from calling parties.

If receiver **10** receives a transmission which is on a proper channel but does not possess an appropriately encoded address, address decoder **20** will not respond and switch controller **30** will not turn on receiver audio **40**. Actuation of switch **120** during the time that this improperly encoded signal is being received however, will cause the receiver audio **40** to turn on so that the user is alerted to the presence of an active or busy channel. The receiver audio therefore serves as an annunciation circuit in the preferred embodiment. It will be clear to those skilled in the art that other ways of alerting the user to the presence of channel activity are readily implemented.

Turning now to FIG. **2** for one embodiment of switch controller **30**, input **135** is coupled to one input of an OR gate **200** and one input of an AND gate **205**. Input **25** is coupled to one input of an AND gate **210**. The output of an AND gate **210** is coupled to a second input of an OR gate **200**. The output of an OR gate **200** drives one input of an AND gate **215** and one input of an OR gate **220**. Input **25** is also coupled to a second input of OR gate **220**. The output of an OR gate **220** is coupled to a reset input **225** of a timer **230**. An output **232** of timer **230** is coupled to the input of an inverter **235** and one input of an AND gate **240**. The output of AND gate **240** is coupled to a third input of an OR gate **220**.

The output of inverter **235** is coupled to the reset input **245** of a counter **250** and the output of AND gate **215** is coupled to a clock input **251** of counter **250**. Counter **250** in this embodiment is preferrably a commercially available Johnson counter with code converter having four digital outputs shown in FIG. **2** and designated **0**, **1**, **2**, and **3** respectively and numbered **252**, **253**, **254** and **255**, respectively in FIG. **2**. However, it will be evident to those skilled in the art that many other types of counter circuits may be substituted for the Johnson counter of this embodiment.

It is understood that counter **250** is reset upon power-up. That is, 1 0 0 0 appears at outputs **0**, **1**, **2**, and **3** respectively upon initial power-up of controller **30**. Also, it is understood that timer **230** is not timing upon power-up of the system. That is, when power is applied a logic zero appears at the output of timer **230**. Although further circuitry which is not shown is required to establish such an initialization, addition of that circuitry is well known and will not add materially to the understanding of the present invention. It will be evi-

dent to one skilled in the art that the design addition of that circuitry is readily accomplished.

The output of inverter **235** is coupled to one input of an OR gate **256** and one input of an AND gate **210**. A second input of an OR gate **256** is coupled to squelch input **65** and the input of an inverter **260**. The output of inverter **260** drives a second input of AND gate **240**. The output of OR gate **256** is the audio enable output **75** of decoder **30**.

Output **255** of counter **250** is coupled to one input of an OR gate **265** and to the input of an inverter **270**. The output of inverter **270** is coupled to a second input of AND gate **215**. Output **254** of counter **250** is coupled to a second input of an OR gate **265**. The output of OR gate **265** is coupled to a second input of AND gate **205**. The output of AND gate **205** is the transmit enable output **105**. Outputs **252** and **253** of counter **250** are not used in controller **30** but are shown here to complete the discription.

Encoder enable output **115** is selectively coupled by a two position jumper or switch **280** to either counter output **254** (if switch **280** is in position A) or transmit enable output **105** (if switch **280** is in position B). If switch **280** is in position A, the address encoder **100** of FIG. **1** will be operative only on the first actuation of switch **120** after the timer starts timing and subsequent transmissions will be unencoded. If switch **280** is in position B, the encoder will be enabled each time a transmission occurs during the timer interval (each time the transmitter is enabled).

FIG. **3** is a timing diagram of the circuit embodiment of FIG. **2**. Although outputs **252** and **253** of counter **250** are not utilized in the circuit of FIG. **2**, they are included in timing diagram FIG. **3** for the purpose of illustrating the operation of the particular type of Johnson counter used in this embodiment. Commercially available Johnson counters such as the MC14022 counter produced by Motorola Inc. as well as other counters are entirely suitable for this application. Similarly, numerous timing circuits, such as analog one-shot type timers and clocked digital counter based circuits, to be used for timer **230** will occur to those skilled in the art.

The timing diagrams of FIG. **3** includes FIGS. **3A** through **3M** wherein FIG. **3A** represents the signal at switch input **135**, FIG. **3B** represents the signal present at the reset input **225** of timer **230** and FIG. **3C** represents the signal present at the output **232** of timer **230**. FIGS. **3D**, **3E**, **3F** and **3G** respectively represent the signals present at outputs **252**, **253**, **254**, and **255** of counter **250**, respectively. FIG. **3H** represents the signal present at transmit enable output **105**. FIG. **3I** represents the signal present at encode enable output **115** in the case of switch **280** set in the A position. FIG. **3J** represents the signal present at squelch input **65**. FIG. **3K** represents the signal present at audio enable output **75**. FIG. **3L** represents the signal present at encoder enable output **115** in the case of switch **280** set to the B position. FIG. **3M** represents the signal present at decoder input **25**.

At a time T1 OF FIG. **3** the user actuates switch **120** for a first time to initiate a call causing a logic high to appear at input **135**. This causes a logic high to appear at the reset input **225** of timer **230** which in turn causes the output **232** of timer **230** to become active and go to a logic high. Counter **250** is clocked at this time causing output **253** to go high, output **252** to go low and outputs **254** and **255** to remain at a logic low. Assuming the squelch input is at a logic high, indicating no channel activity, the user will hear that he has a clear channel and will release switch **120** at time T2. This causes a low going logic transition at the reset input **225** of timer **230** which causes the timer to begin timing its predetermined time interval.

At time T3, the timer interval started at time T2 has not yet expired, and the user once again actuates switch **120** causing a low to high logic transition at input **135**. This once again resets timer **230** holding its output high and causes counter **250** to be clocked to its next state wherein output **254** is at logic high and outputs **252**, **253** and **255** are at logic lows. This state of the counter causes a logical low to high signal transition at transmitter enable output **105** and encoder enable output **115**. This causes the transmitter to be active and the encoder to provide the transmitter with the address of the party being called. This occurs whether switch **280** is in either position A or B. Since the output of the timer is held high by the constant reset input caused by actuation of switch **120**, the audio is always disabled when the transmitter is enabled. Normally the encoder will require only a very brief period of time (typically less than 0.5 seconds) to encode an address to be transmitted by the transmitter. During this time, the transmitter will normally mute the microphone **90** of FIG. **1** and transmit the code address.

After the code address has been transmitted, the microphone **90** will be unmuted and voice transmission may proceed. Alternately, if data transmission is desired it may take place after the addressing process is completed. At the end of the voice or data transmission, switch **120** is deactuated at a time corresponding to T4 of FIG. **3**. The deactuation disables the transmitter and, if switch **280** is in position A, disables the encoder. The low transition at the reset input **225** of timer **230** once again causes the timer to begin its predetermined time interval.

At time T5 the party being called responds with a transmission of his own. This causes squelch input **65** of the formerly transmitting and now receiving unit to go to a logic low causing audio enable output **75** to go low turning on the receiver's audio allowing the user to hear the message being received. The received audio also turns on the reset input **225** of timer **230** thereby holding the output at a logic high. At time T6 the received message ends causing the squelch input **65** to go back to a logic high which in turn causes the audio to be disabled by the high going transition at output **75**. The change at input **65** causes timer **230** which had been reset by the logic high on input **65** to start its time interval once again.

At time T7, the user once again actuates switch **120** to respond to the message received between T5 and T6 causing input **135** to go high and reseting the timer. The counter is once again clocked to the next count causing its output **255** to go to a logic high while outputs **252**, **253** and **254** are at a logic low. The transmitter is enabled by output **105** and, if switch **280** is in position B, the encoder **100** of FIG. **1** is once again enabled. If switch **280** is in position A an unencoded transmission will occur. If the encoder **100** is enabled, voice or data may be transmitted after the address is encoded and transmitted. If the encoder is not enabled voice or data information may be transmitted immediately.

At time T8 switch **120** is deactuated causing input **135** to once again return to a logic low. This causes a high to low transition at the timer reset input **255** which

restarts the timing of the predetermined time interval. The signal at output **255** of counter **250** is fed back through inverter **270** and AND gate **215** to prevent further actuations occurring while the output **232** of timer **230** is active (logic high) from clocking counter **250**. Therefore, there is no change in counter outputs **252**, **253**, **254** or **255** on any subsequent transmission unless timer **230** times out to the end of its time interval. This will cause the counter **250** to reset to its original state prior to time **T1**.

The time interval from **T9** to **T10** represents a received message similar to that occuring between time **T5** and **T6**. Although counter **250** is at a different count, the controller **30** responds to this incoming message in a manner identical to its response between **T5** and **T6**. Similarly, the decoder responds to subsequent transmissions such as that occuring between time **T11** and **T12** the same as transmissions occuring between time **T7** and **T8** as long as the timer output **232** is at a logic high.

At time **T13** the output **232** of timer **230** becomes inactive and goes to a logic low indicating that the predetermined time interval of timer **230** has expired. This resets counter **250** to its initial state just prior to time **T1**. Actuations of switch **120** occuring subsequent to time **T13** will cause controller **30** to respond as it did at time **T1** restarting the entire cycle.

At time **T14**, the response of controller **30** to correctly encoded incoming messages is shown. That is, the conversation is inititated by another transceiver addressing the transceiver of the present user. At this time input **25** makes a low to high transition as a result of a correctly decoded address by decoder **20**. This causes a logic low to logic high transition at the timer reset input **225** which in turn causes the timer output **232** to go high. The incoming signal at input **25** also causes counter **250** to be clocked causing its output **253** to go high and its output **252** to go low. Outputs **254** and **255** remain at a logic low. Since a decoder output implies that a signal is being received, squelch input **65** makes a logic high to a logic low transition and audio enable output **75** goes low turning on the receivers audio circuits.

At time **T15** the incoming message ends causing the timer **230** to begin timing its predetermined interval and the audio to be disabled. It should be noted that after time **T15** controller **30** is in exactly the same set of logic states that it was in after time **T2**. Therefore it is evident that a response by the user of actuating switch **120** will cause the same response as that which occurred at time **T3**. That is, a transmission with an encoded address will occur. It will be evident to those skilled in the art, that the minor modification of causing no address encoding when communication is initiated by receipt of a correctly encoded incoming message may be readily implemented by clocking counter **250** more than once as a result of a logic high at the output of AND gate **210**.

Turning now to FIG. **4**, it will be evident to one skilled in the art that a microprocessor or microcomputer is ideally suited to perform the functions of controller **30** in an equivalent embodiment shown in FIG. **4** as system **300**. In this system a microcomputer **310** along with its associated "code plug" ROM **320** will preferrably perform the functions not only of controller circuit **30** but also of other radio functions such as that of the address decoder **20** and address encoder **100** of the system of FIG. **1** but this is not intended to be limiting. In this system, micro-computer **310** accepts incoming information from receiver **10**, squelch circuit **60**, and switch **120** and delivers appropriate signals to receiver audio **40** and transmitter **325**. It will be appreciated that transmitter **325** may alternately include an encoder such as encoder **100** and receiver **10** may alternately include a decoder such as decoder **20**. Preferrably, however, the micro-computer would handle these functions. Micro-computers such as the widely available Motorola MC146805G2 as well as others is suitable for performing these functions.

In this embodiment, ROM **320** serves as a "code plug" which is used to program the transceiver with various options and information necessary to the transceivers standard operation. Information such as tone duration, tone frequency, etc may be stored therein and programmed to meet various user or system requirements. The switch **280** of controller **30** is preferrably replaced by one bit of digital information in ROM **320** for system **300**.

FIG. **5** shows a flow chart of one method of programming micro-computer **310** to perform the functions of the present invention. This flow chart is designed to parallel the operation of hardware switch controller **30** and the reader should be aware that decision blocks do not uniformly show the result of a "yes" answer at the bottom of the diamond shaped blocks. It will occur to those skilled in the art that many other flow charts will result in firmware which will equally well perform the desired functions, therefore, the flow chart of FIG. **5** is not intended to be limiting as the only program sequence which would perform the function of the present invention.

Program step **400** of the flow chart of FIG. **5** encompasses the first steps of the program wherein a timer, counter and other circuitry will be initialized upon powering up the system. The program looks for a switch actuation at step **410** and if none is found proceeds to step **420** where the receiver squelch circuit is inspected to see if a radio frequency carrier is present. If carrier is present the timer is reset and a brief delay occurs at steps **430** and the program is returned to step **410**. If the switch has been actuated step **440** checks to see if the timer is running. If not, step **450** enables the audio until step **460** detects a switch release. Until the switch release occurs periodic delays are encountered through steps **470** until the switch is released.

When the switch is released the timer is reset at step **480** and the program returns to step **410**. If at step **440** it is determined that the timer is running, step **490** clocks the counter. If the counter's count equals 2 at step **500**, the encoder is activated along with the transmitter at step **510**. The transmitter remains activated until steps **520** and **530** determine that the switch has been released. At that point. Step **540** stops transmission and step **550** resets the timer. The program is then returned to step **410**.

If at step **500** the count is not equal to two, step **560** disables the clock to the counter. Step **570** determines whether or not the user desires to encode upon each transmission or not. If so the program returns to step **510** and if not the program simply turns on the transmitter at step **580** without enabling the encoder. The program then proceeds to step **520**.

If at step **420** it is determined that carrier is not present, step **590** determines if a message has been is properly encoded and correctly decoded. If not step **600** checks to see if the timer's interval has expired. If not a delay is encountered at step **610** prior to returning the program to step **410**. If the timer's interval has expired

at step **600**, the audio is muted at step **620** and the timer is reset at step **630**. The program then returns to step **410**.

If at step **590** the signal was appropriately decoded, step **635** checks to see if the timer is running. If so, step **640** resets the timer and step **660** enables the receiver's audio. The program then returns to step **410**. If at step **635** the timer is not running, step **665** clocks the counter, step **670** resets the timer, step **675** enables the timer and step **680** enables the audio. The program then returns to step **410**. If it is desirable not to transmit an address code on the first actuation of the switch **120** occuring after receipt of a correctly encoded message, step **665** should clock the counter twice, otherwise an address will be encoded on the first transmit.

Turning now to FIG. **6** a diagram of the actual hook up for the preferred firmware embodiment of the present invention is shown. This embodiment utilizes the Motorola MC146805G2P microcomputer in conjunction with the MCM2802P programmable ROM. The details of using this particular widely available microprocessor/microcomputer family are well known and documented in the "M6805/M146805 Family Microcomputer/microprocessor User's Manual" published by Motorola, Inc., 3501 Ed Bluestein Blvd., Austin, Tex. 78721. The contents of the above referenced manual is hereby incorporated by reference. Details of the microprocessor itself may be found in the commonly published "Motorola Microprocessor Data Manual" in the section entitled "MC146805G2", the contents of which is also hereby incorporated by reference. In FIG. **6**, the actual transceiver functions are represented in block diagram form and one skilled in the art will readily know how to accomplish the appropriate interfacing to those functions. Also, pin numbers for the plastic dual in-line package versions of the microcomputer and ROM are circled and shown adjacent the appropriate I.C. terminals.

TABLE I

0000	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0020	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0030	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0060	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0070	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
0080	24	04	16	01	20	02	17	01	18	01	19	01	81	A6	60	B7
0090	09	A6	21	B7	04	AE	10	A6	14	B7	3B	A6	0A	B7	3D	CD
00A0	00	ED	3A	3D	26	F9	B6	10	26	04	9C	CC	06	42	81	B7
00B0	3B	A6	4E	B7	3A	20	06	B7	3B	A6	46	B7	3A	A6	08	B7
00C0	3C	BE	3A	F6	3C	3A	BE	3B	F7	3C	3B	3A	3C	26	F2	81
00D0	4F	05	01	00	49	0F	02	00	49	81	14	72	18	72	05	3F
00E0	05	05	6C	02	1A	68	3F	69	3F	6A	3F	6B	81	1F	03	16
00F0	05	1A	01	17	01	BD	88	BD	88	B6	77	46	BD	80	46	BD
0100	80	B6	3B	B7	3C	38	3C	38	3C	38	3C	A6	08	38	3C	BD
0110	80	4A	26	F9	17	05	A6	20	1B	01	20	02	BD	88	06	01
0120	00	79	69	01	69	02	69	03	4A	26	F1	9F	AB	04	97	3C
0130	3B	1E	03	81	BD	8D	AE	2E	20	04	BD	8D	AE	30	12	72
0140	B6	2D	B7	65	B6	28	B7	3C	20	1E	BD	8D	B6	29	B7	3C
0150	AE	56	B6	2B	20	0E	1A	00	20	2A	BD	8D	B6	2A	B7	3C
0160	AE	5B	B6	2C	27	F0	B7	65	1A	00	A6	02	B7	3D	A6	8C
0170	B7	08	A6	07	B7	09	8F	A6	08	4A	26	FD	3A	3D	26	EE
0180	3A	65	26	E6	A6	60	B7	09	02	72	2A	A6	FF	B7	75	A6
0190	05	B7	44	BF	39	21	FE	BE	39	F6	A4	0F	A1	0F	26	03
01A0	CC	02	62	B1	75	26	08	A6	0F	B7	75	A6	24	20	05	B7
01B0	75	48	AB	10	97	F6	B7	37	B7	45	E6	01	B7	38	0E	72
01C0	3A	A6	FC	B7	07	A6	94	B7	03	B6	38	B7	08	3F	09	8F
01D0	A6	02	9D	4A	26	FD	A6	9C	B7	03	B6	38	B7	08	3F	09
01E0	8F	B6	38	B7	08	3F	09	8F	A6	02	9D	9D	4A	26	FD	01
01F0	72	12	0F	01	0A	A6	60	B7	09	20	65	A6	EC	20	C4	1E
0200	37	9D	20	08	9D	9D	9D	9D	9D	9D	21	FE	A6	84	B7	03
0210	B6	38	B7	08	3F	09	8F	A6	02	9D	4A	26	FD	A6	80	B7
0220	03	B6	38	B7	08	3F	09	8F	B6	38	B7	08	3F	09	8F	21
0230	FE	9D	9D	9D	9D	3A	37	26	0B	3A	3C	27	12	B6	45	B7
0240	37	CC	01	C5	9D	21	FE	9D	9D	9D	9D	9D	CC	01	C5	9D
0250	9D	9D	9D	21	FE	A6	84	B7	03	A6	01	B7	3C	03	72	07
0260	13	72	A6	94	B7	03	81	3A	44	27	F7	3C	39	A6	07	4A
0270	9D	26	FC	CC	01	95	A6	60	B7	09	80	04	68	7B	06	68

TABLE I (cont'd)

```
0280 03 CC 03 8D BD D0 B8 77 27 05 1C 09 CC 06 17 0B
0290 68 08 0B 3F 05 07 00 02 BD DE 17 68 AE 01 A6 FE
02A0 B7 3D B7 02 09 02 38 5C 0B 02 34 5C 0D 02 30 5C
02B0 39 3D B6 3D B7 02 08 3D EB 03 68 15 3A 66 26 11
02C0 11 68 13 68 A6 21 B7 04 10 00 0E 68 04 15 6C 3F
02D0 70 81 B7 67 12 68 A6 01 B7 66 81 A6 03 20 F9 BF
02E0 73 9F 03 68 ED B1 67 26 D3 00 68 EF 3C 66 A6 03
02F0 B1 66 26 DD 10 68 14 68 81 15 68 1D 03 B6 73 A1
0300 0A 27 6E A1 0C 26 1D A6 E0 B7 04 B6 76 B7 00 1D
0310 68 AE 55 5C A3 60 24 4D F6 2A F8 BF 74 B6 42 B7
0320 71 18 68 81 A1 0B 26 02 3F 73 09 43 10 B1 63 26
0330 0C B6 62 B1 74 27 4B AB 05 B1 74 27 45 0B 43 06
0340 B6 73 B1 61 27 3C A6 E0 B7 04 B6 76 B7 00 1D 68
0350 09 68 19 B6 73 BE 74 AA 80 F7 5C A3 60 24 06 F6
0360 2A F8 BF 74 81 19 68 A6 C0 B7 71 81 B6 42 B7 71
0370 81 0D 04 03 0C 00 15 0D 71 08 1B 72 BD DA 7C CC
0380 05 62 A6 E6 B7 04 B6 76 B7 00 1D 68 81 16 68 B6
0390 6A A4 1E 27 04 1D 07 20 02 1C 07 B6 6C B7 6D 01
03A0 01 0F 01 6D 08 3A 6E 27 13 10 6C 20 11 3F 6E 20
03B0 0B 00 6D F5 3C 6E A6 03 B1 6E 27 ED 11 6C 0F 01
03C0 0F 03 6D 08 3A 6F 27 13 12 6C 20 11 3F 6F 20 0B
03D0 02 6D F5 3C 6F A6 03 B1 6F 27 ED 13 6C 0F 43 12
03E0 08 00 12 05 6D 08 3A 70 27 16 14 6C 20 14 3F 70
03F0 20 0E 08 00 EE 04 6D F2 3C 70 A6 03 B1 70 27 EA
0400 15 6C B6 6D B8 6C 27 62 1B 72 10 04 1D 03 46 24
0410 2D 01 6C 2C 1E 68 BD DE 05 6C 14 07 3F 0B 05 72
0420 19 08 3F 05 08 72 0E 18 72 16 72 B6 43 20 61 14
0430 72 18 72 20 E6 16 72 9C 20 76 14 72 20 1A 1B 68
0440 46 24 09 03 6C 06 1F 04 B6 42 20 44 46 24 1A 1F
0450 68 04 6C 07 14 72 18 72 1D 04 81 15 72 19 72 1C
0460 04 0F 43 03 1D 00 81 1C 00 81 B6 35 48 BB 69 B7
0470 69 4F B9 6A B7 6A 4F B9 6B B7 6B 0C 43 0E B1 60
0480 26 E7 0B 68 E4 1F 68 AD D2 1B 68 81 B6 6A 20 EE
0490 B7 3A 9C A6 21 B7 04 B6 3A A4 0C A1 08 26 3D 06
04A0 72 03 CC 05 39 03 3A 08 00 3A 0B CD 01 34 20 0C
04B0 A6 60 B7 09 20 06 03 01 F2 CD 01 3A 1A 00 1D 03
04C0 A6 FF B7 08 A6 05 B7 09 8F 01 01 0A 3A 6E 26 F0
04D0 17 72 11 6C 20 3F A6 03 B7 6E 20 E4 05 3A 0E 06
04E0 3A 05 CD 01 34 20 06 03 01 F8 CD 01 3A 01 3A 35
04F0 03 3A 0F 0D 71 32 CD 01 4A CD 01 5A 20 10 9D 9D
0500 20 13 0F 71 2B CD 01 5A 0D 71 03 CD 01 4A 0A 42
0510 ED B6 42 B7 71 A6 CE B7 07 A6 84 B7 03 06 72 9C
0520 1B 00 CC 06 6A 02 3A 05 0F 71 05 20 CC 0C 71 DB
0530 06 72 DB 04 42 D8 CC 06 D8 03 3A 10 00 3A 05 CD
0540 01 34 20 D1 03 01 F8 CD 01 3A 20 C9 10 72 01 3A
0550 08 03 01 05 CD 01 3A 20 03 CD 01 34 11 72 13 6C
0560 20 B3 09 42 A6 20 8F 9C BD 8D A6 01 B7 3C A6 04
0570 B7 65 A6 80 B7 72 AE 32 CD 01 68 1B 00 CC 06 17
0580 A6 60 B7 09 1D 03 1E 68 0C 72 10 01 3F 0D CD 01
0590 5A A6 CE B7 07 A6 84 B7 03 1B 00 03 3F 30 1A 72
05A0 1C 68 0D 72 47 A6 D2 B7 3C A6 E2 B7 04 B6 76 B7
05B0 00 A6 5D B7 08 A6 06 B7 09 CD 02 7B 8F 21 FE 0B
05C0 72 0C 0D 68 13 3A 3C 27 05 0C 72 E5 20 38 1B 72
05D0 1D 68 A6 21 B7 04 10 00 0D 72 0C 0D 3F 04 1C 07
05E0 1C 03 BD DA CC 06 6A 0F 3F F8 20 F2 A6 7D B7 3C
05F0 A6 12 B7 3B A6 E4 B7 04 B6 76 B7 00 A6 9C B7 08
```

```
0600 A6 06 B7 09 20 B3 3A 3B 26 F2 00 04 E3 A6 07 B7
0610 3B 10 04 10 00 20 E5 9C A6 21 B7 04 A6 01 B7 00
0620 A6 30 B7 05 A6 0F B7 06 A6 CE B7 07 A6 84 B7 03
0630 4F B7 01 B7 02 B7 6C B7 6E B7 6F B7 70 B7 72 B7
0640 68 9A BD D0 B7 77 A6 0A B7 3B AE 3E A6 0A B7 3D
0650 BD ED 3A 3D 26 FA B6 44 BB 45 A1 A5 26 E4 B6 42
0660 B7 71 4F 0F 43 02 A6 C0 B7 76 9C B6 40 B7 45 B6
0670 3E B7 39 3F 37 1D 72 A6 60 B7 09 CD 08 28 3F 3C
0680 3F 3D AE 10 CD 08 17 AE 23 CD 08 17 B6 22 B7 14
0690 B6 20 B7 12 B6 21 B7 13 B6 34 B7 26 B6 35 44 44
06A0 44 B7 27 A6 70 B7 08 3F 09 3F 36 B6 14 B0 27 2B
06B0 12 1A 36 26 04 B6 35 20 0B B7 14 BE 27 B6 35 B7
06C0 27 20 0B 40 B7 27 BE 14 B6 22 B7 14 14 36 8F CD
06D0 07 3C 04 36 03 CD 02 7B B6 36 A4 09 26 05 03 36
06E0 C8 20 B7 07 36 05 01 39 02 1C 72 3C 37 34 39 B6
06F0 41 B1 37 26 B2 CC 05 80 B6 32 BB 29 B7 29 B6 31
0700 B9 28 B7 28 0D 01 18 2B 0B 0C 28 04 3C 2A 20 27
0710 3C 2B 20 23 0C 28 04 3C 2C 20 1C 3C 2D 20 18 2B
0720 0B 0C 28 04 3A 2A 20 0F 3A 2B 20 0B 0C 28 04 3A
0730 2C 20 04 3A 2D 20 00 5A 27 42 21 00 B6 1F BB 16
0740 B7 16 B6 1E B9 15 B7 15 0D 01 18 2B 0B 0C 15 04
0750 3C 17 20 A4 3C 18 20 A0 0C 15 04 3C 19 20 99 3C
0760 1A 20 95 2B 0B 0C 15 04 3A 17 20 8C 3A 18 20 88
0770 0C 15 04 3A 19 20 81 3A 1A CC 06 F8 A6 AD C7 00
0780 08 A6 02 B7 09 B6 1C BB 16 B7 16 B6 1B B9 15 B7
0790 15 B6 2F BB 29 B7 29 B6 2E B9 28 B7 28 05 36 05
07A0 AE 10 CD 07 AE 0B 36 05 AE 23 CD 07 AE 81 E6 0C
07B0 B7 25 E6 08 E0 0A B7 3C E6 07 E0 09 B7 3B BB 3C
07C0 00 25 01 47 B7 3D B6 3B B0 3C 00 25 01 47 B7 3C
07D0 EB 01 2A 01 40 B7 3B B6 3D FB 2A 01 40 BB 3B E1
07E0 0D 23 10 6A 03 26 14 A3 10 26 04 10 36 20 0C 16
07F0 36 20 08 E6 03 E1 11 27 02 6C 03 B6 37 27 15 0A
0800 36 12 3A 12 26 0E A1 01 26 08 B6 20 B7 12 3A 45
0810 26 02 12 36 00 25 07 B6 3D F7 B6 3C E7 01 4F E7
0820 07 E7 08 E7 09 E7 0A 81 A6 1B B7 3A 0E 3E 03 0C
0830 72 37 01 39 02 A6 4E B7 3A B6 1B 00 36 02 B6 2E
0840 B7 3D B6 37 48 B7 3B AE 1B BD ED BD ED A6 2E B7
0850 3B BD BD B6 37 27 2A B6 1B B1 3D 26 04 A6 1B BD
0860 B7 B6 2E B1 3D 26 1A 20 0A B6 2E B1 4E 26 0A A6
0870 1B BD B7 A6 2E BD B7 20 08 A6 1B BD AF A6 2E BD
0880 AF 81 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0890 43 6F 70 79 72 69 67 68 74 20 31 39 38 32 20 20
08A0 4D 6F 74 6F 72 6F 6C 61 20 49 6E 63 2E 20 20 20
1FF0 00 00 00 00 00 00 02 76 06 17 05 67 06 17 06 17
```

TABLE II

```
9A 01 29 33 40 0D 04 5C 9A 01 29 33 40 0D 04 5C
9A 01 29 33 40 0D 04 5C 9A 01 29 33 40 0D 04 5C
9A 01 29 33 40 0D 04 5C 00 2E 01 05 C0 0A A0 05
E4 91 3A 3C 92 0D 04 55 BF 49 26 37 E9 0D 04 55
80 80 09 09 09 0A 01 09 09 09 05 AA AA AA 00 00
A7 0D 4A 64 51 57 59 4A 62 3E 6B 34 75 2B 80 22
8D 1A 9A 13 B7 07 C3 03 05 01 01 04 04 04 54 52
54 52 0A 05 09 09 09 00 00 00 00 00 00 00 00 79
```

When the hexadecimal program code shown in Table I is loaded into the microcomputer's internal memory and the code shown in Table II is loaded into the programmable ROM, the circuit will perform in a manner substantially the same as that of controller **30** with switch **280** in the A position and in addition will perform the decoding function for a 9-9-9-9-9 ZVEI code on data entering the PB6 input. If an encode is desired on each transmission (switch **280** in the B position), the tenth byte in line 3 of Table II should be changed from 2E to 3E. Also, the encoding function is performed and the output appears in the form of a 350 millisecond,

1200 Hz tone in digital form at outputs PD2 and PD3 when the microcomputer is clocked at a bus speed of 1 MHz. This output is processed by a two bit D/A converter **690** and a low pass filter **695** prior to being transmitted by transmitter **325**. The output of receiver **10** is processed by a low pass filter **700** and then limited by a limiter **710** prior to input into the **PB6** terminal of the microcomputer.

Thus, it is apparent that in accordance with the present invention a method and apparatus that fully satisfies the objects, aims, and advantages is set forth above. While the invention has been described in conjucntion with specific embodiments, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended that the present invention embrace all such alternatives, modifications and variations as fall within the spirit and broad scope of the appended claims.

What is claimed is:

1. In a transceiver including a transmitter and a receiver, a multiple function switch controller for controlling the transceiver by the operation of a switch, comprising:

a timer responsive to said switch for establishing a time interval, the duration of said time interval being independent of the operation of said switch;

first means, coupled to said timer and responsive to actuation of said switch occuring during said time interval, for producing a first transceiver control signal wherein said first control signal establishes a first operational mode for said transceiver; and

second means, coupled to said timer and responsive to actuation of said switch occuring outside of said time interval, for producing a second transceiver control signal wherein said second control signal establishes a second operational mode for said transceiver;

whereby, said switch controller allows said switch to control a plurality of transceiver functions.

2. A multiple function switch controller in accordance with claim **1**, further including:

means, responsive to said first control signal, for selectively enabling said transmitter; and

annunciating means, responsive to said second control side, for annunciating the presence of activity on a selected communication channel.

3. A multiple function switch controller in accordance with claim **2**, wherein said annunciating means in includes means for selectively directing audio frequency signals to a loudspeaker.

4. A multiple function switch controller in accordance with claim **2**, further including an encoder coupled to said controller and said transmitter for encoding an address to be transmited by said transmitter;

said encoder being enabled whenever said transmitter is enabled.

5. A multiple function switch controller in accordance with claim **1**, further including a counter for counting the number of actuations of said switch occuring during said time interval.

6. A multiple function witch controller in accordance with claim **5**, further including gating means, responsive to said counter, for providing a third control signal only on predetermined counts of said counter.

7. A multiple function switch controller in accordance with claim **6**, further including an encoder coupled to said transmitter for encoding an address to be transmitted by said transmitter; and wherein said third control signal allows said encoder to be enabled ony when said counter indicates that switch is being actuated for a first time within said time interval.

8. A multiple function switch controller in accordance with claim **7**, wherein said encoder includes a five tone sequential selective calling encoder.

9. A method of controlling the operation of a switch in a transmitter, comprising the steps of:

timing an interval following operation of said switch, the duration of said time interval being independent of the operation of said switch;

actuating said switch outside said time interval;

alerting the user of the status of a communication channel upon actuation of asid switch outside of said time interval; actuating said switch during said time interval; and

enabling said transmitter upon actuation of said switch occuring during said time interval.

10. A method in accordance with claim **9**, further including the steps of:

enabling an encoder upon a first of said actuations of said switch occuring during said time interval; and

inhibiting said encoder upon subsequent actuations of said switch occuring during said time interval.

11. In a transceiver including a transmitter and a receiver, a multiple function switch controller, comprising:

means for detecting operation of a switch;

means coupled to said receiver for monitoring the activity of a selected communication channel;

a timer, responsive to either said monitoring means or said detecting means, for establishing a time interval, the duration of said time interval being independent of the operation of said switch;

means, responsive to actuation of said switch during said time interval, for enabling said transmitter; and

means, responsive to actuation of said switch outside of said time interval, for annunciating the status of said communication channel.

12. A multiple function switch controller in accordance with claim **11**, further including:

means for detecting a first actuation of said switch occuring during said time interval; and

means for enabling an encoder during said first actuation.

13. A multiple function switch controller in accordance with claim **12**, further including means for inhibiting said encoder during second and subsequent actuations of said switch occuring during said time interval.

14. In a transceiver ncluding a transmitter and a receiver, a multiple function switch controller, comprising:

means for detecting actuation of a switch;

a decoder coupled to said receiver, for decoding received signals of a predetermined type;

a timer, responsive to either said detecting means or said decoder, for establishing a time interval following each switch actuation or each decoding of a received signal of a predetermined type; and

controller means, responsive to said timer and said switch, for placing said transceiver in a first mode of operation if said switch is actuated during said time interval and placing said transceiver in a second mode of operation if said switch is actuated outside of said time interval

15. A multiple function switch controller in accordance with claim **14**, wherein:

said first mode of operation is associated with said transmitter; and

said second mode of operation is associated with said receiver.

16. In a selective calling transceiver including a transmitter and a receiver, a multiple function switch controller for controlling the transceiver by the operation of a switch, comprising:

a decoder for decoding a received signal including a predetermined address;

a timer, responsive to said decoder, for establishing a time interval following each decoding of a received signal including a predetermined address;

first means, responsive to actuation of said switch during said time interval for producing a first transceiver control signal; and

second means responsive to actuation of said switch outside of said time interval for producing a second transceiver control signal.

17. A multiple function switch controller in accordance with claim **16**, wherein said first control signal establishes a first operational mode for said transceiver and said second control signal establishes a second operational mode for said transceiver.

18. A multiple function switch controller in accordance with claim **17**, further including:

means, responsive to said first control signal, for selectively enabling said transmitter; and

annunciating means, responsive to said second control signal, for annunciating the presence of activity on a selected communication channel.

19. A multiple function switch controller in accordance with claim **18**, wherein said timer is also activated in response to said switch.

20. A multiple function switch controller in accordance with claim **19**, further including means, responsive to actuation of said switch during said time interval, for enabling an encoder.

21. A multiple function switch controller in accordance with claim **20**, further including a counter means for counting the number of actuations of said switch during said time interval.

22. A multiple function switch controller in accordance with claim **21**, further including gating means, responsive to said counter for allowing said encoder to be enabled only on predetermined counts of said counter.

23. A multiple function switch controller in accordance with claim **22**, wherein said gating means allows said encoder to be enabled only when said counter indicates that said switch is being actuated for a first time within said time interval.

24. A multiple function switch controller in accordance with claim **21**, wherein said annunciating means includes means for selectively directing audio frequency signals to a loudspeaker.

25. In a transmitter, a method of controlling a switch, comprising the steps of:

providing a timer responsive to said switch for establishing timing intervals in response to operation of said switch;

detecting whether or not an output of said timer is a predetermined signal;

counting actuations of said switch occuring while said timer output is said predetermined signal to establish a count;

enabling said transmitter upon actuation of said switch occuring while said output is said predetermined signal;

enabling an encoder to encode said transmitter's transmitted signal when said count equals a first predetermined count; and

inhibiting said encoder when said count is equal to a second predetermined count.

26. In a transceiver including a tramsitter and a receiver, a switch controller for controlling the transceiver by the operation of a switch, comprising:

a timer for establishing a time interval in response to said switch,

first means, coupled to said timer and responsive to actuation of said switch during said time interval, for producing a first control signal to selectively enable said transmitter;

second means, coupled to said timer and responsive to actuation of said switch outside of said time interval, for producing a second control signal;

annunciating means, responsive to said second control signal, for annunciating the presence of activity on a selected communication channel; and

a counter for counting actuations of said switch occuring during said time interval.

27. A switch controller in accordance with claim **26**, further including gating means, responsive to said counter, for providing a third control signal only on predetermined counts of said counter.

28. A switch controller in accordance with claim **27**, further including an encoder coupled to said transmitter for encoding an address to be transmitter by said transmitter; and wherein said third control signal allows said encoder to be enabled only when said counter indicates that said switch is being actuated for a first time within said time interval.

29. A switch controller in accordance with claim **28**, wherein said encoder includes a five tone sequential selective calling encoder.

30. A switch controller in accordance with claim **29**, wherein said annunciating means includes means for selectively directing audio frequency signals to a loudspeaker.

31. In a selective calling transceiver including a transmitter and a receiver, a switch controller for controlling the transceiver by the operation of a switch, comprising:

a decoder for decoding a received signal including a predetermined address;

a timer, responsive to said decoder and said switch, for establishing a time interval folllowing each decoding of a received signal including a predetermined address and following predetermined operations of said switch;

first means, responsive to actuation of said switch during said time interval for producing a first control signal;

means responsive to said first control signal for selectively enabling said transmitter;

second means, responsive to actuation of said switch outside said time interval for producing a second control signal,

annunciating means responsive to said second control signal for annunciating the presence of activity on a selected communication channel;

means responsive to predetermined actuations of said switch during said time interval for enabling an encoder; and

counter means for counting actuations of said switch during said time interval.

* * * * *